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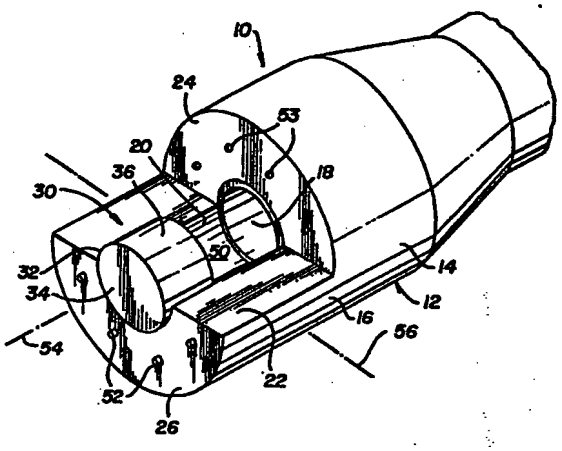
(54) Coupling system, especially for a connector.

(57) A hermaphroditic coupling system, especially for an optical fibre (or electrical) connector member. The connector member (10) has a body (12) with a cylindrical portion (14) and a semi-cylindrical extension (16), defining a stepped end profile comprising rearward and forward spaced parallel semi-annular transverse surfaces (24, 26) and a planar portion (22) between them, this structure having 180° rotational symmetry about a transverse axis (56). A channel (20) is formed in the extension (16) as a continuation of a bore (18) in the portion (14) forming a recess. A boss (32) is in the channel (20) and has a projecting end (34) projecting forwardly of surface (26). A domed abutment surface (44) on an abutment member (42) resiliently mounted by a spring (40) at the rear of the boss faces rearwardly towards the bore (18). The space (50) between the boss (32) and the end surface (24) of the body portion (14) is sufficient to receive laterally the boss on an opposed identical connector member (58) when the abutment members are depressed. When the connectors are axially aligned they move together longitudinally under the action of the springs (40) to engage the projecting end (34) of the boss (32) in the end of the bore (18). The connector member is of simple construction and can provide both a snap-in and a snatch-release capability.



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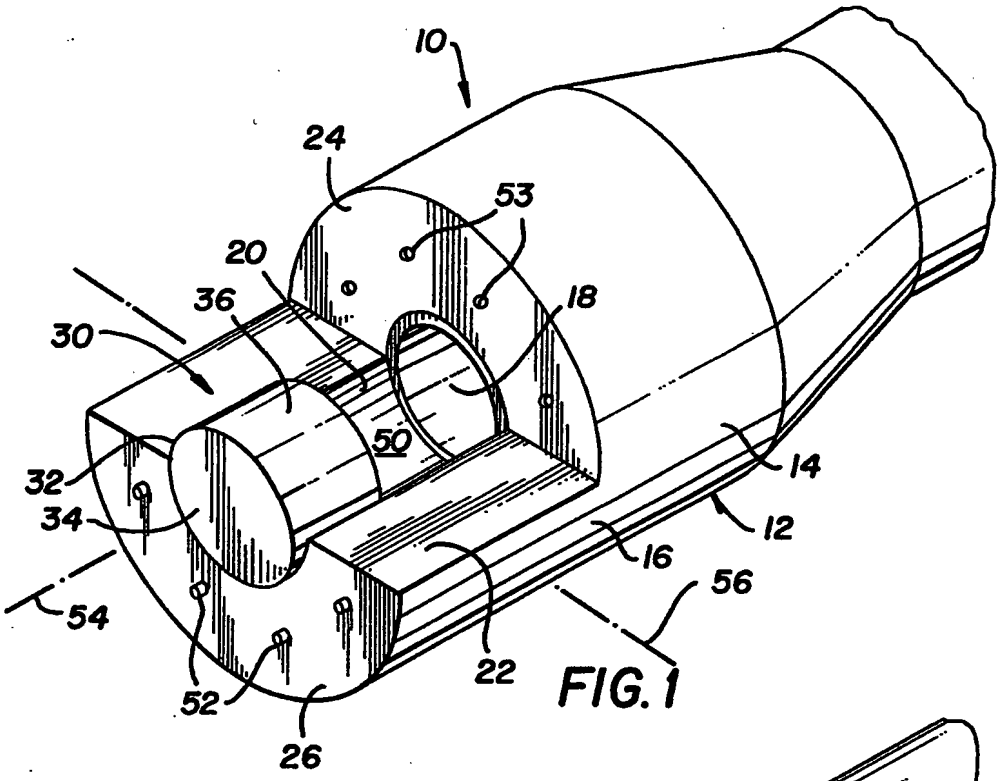
10
24
53
20
36
18
30
50
32
14
34
12
16
56
54
22
52
26

FIG. 1

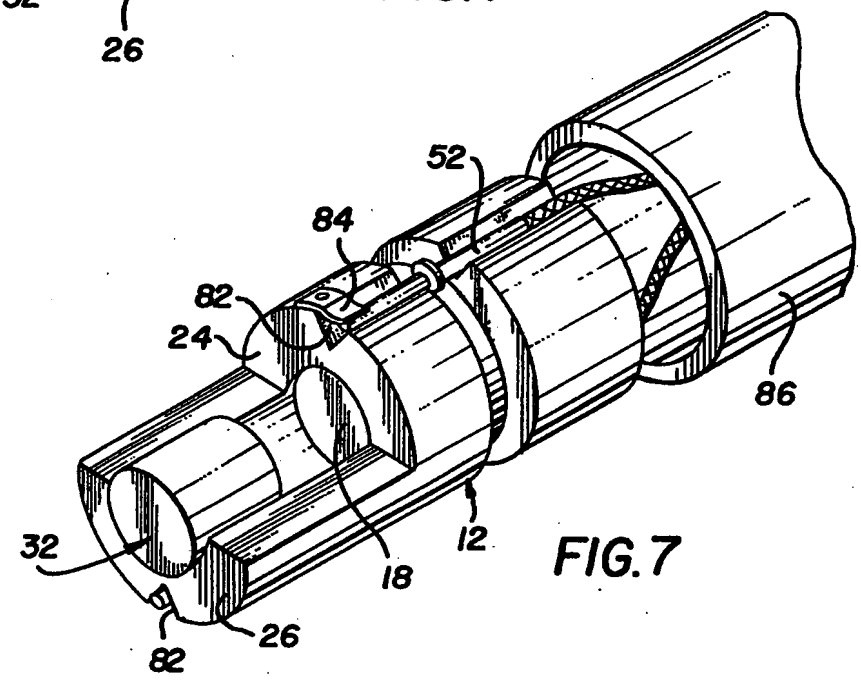
52
84
82
24
86
12
32
18
26
82

FIG. 7

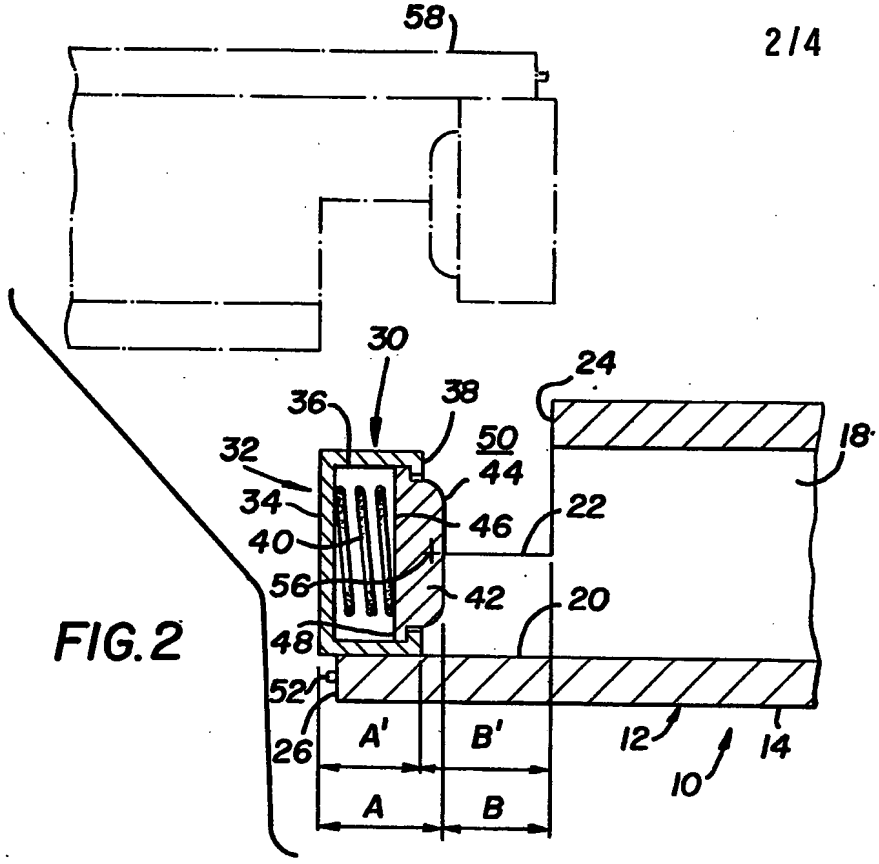
58
214
30
36
38
24
18
32
50
44
34
46
22
40
56
42
20
48
52
26
A'
B'
12
14
10
A
B

FIG. 2

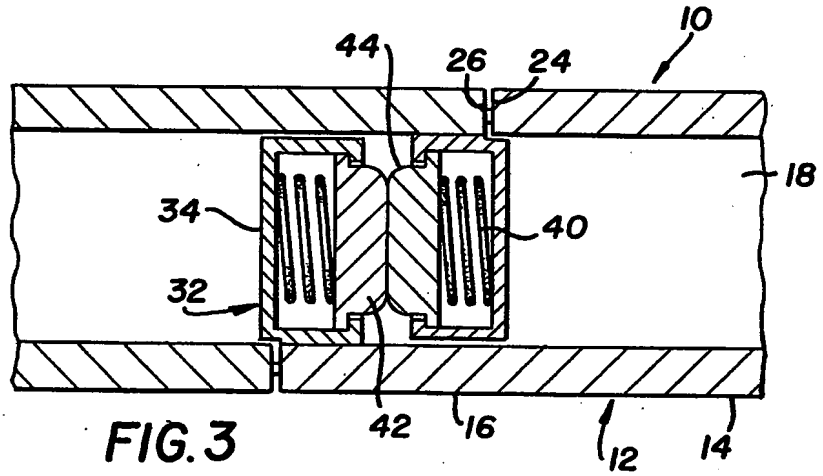
10
44
26
24
18
34
40
32
42
16
12
14

FIG. 3

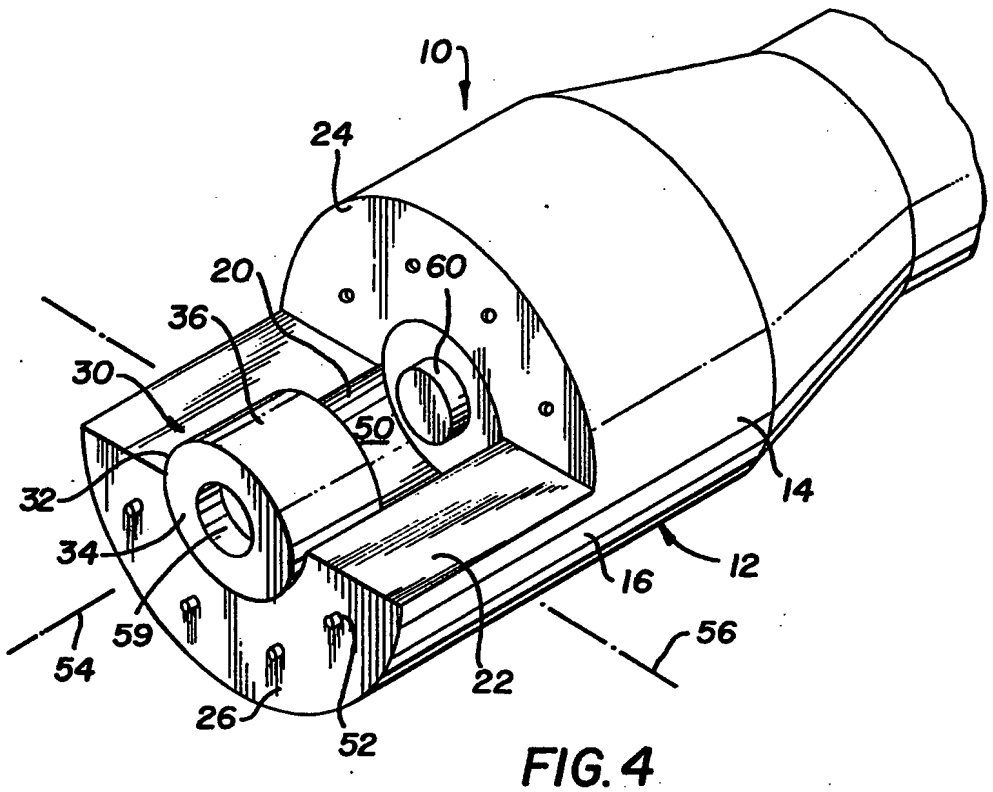

FIG. 4

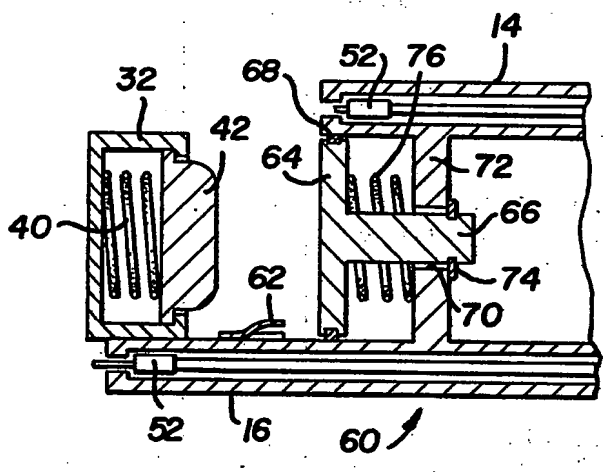
14
52
76
68
32
42
64
72
66
40
74
62
70
52
16
60

FIG.5

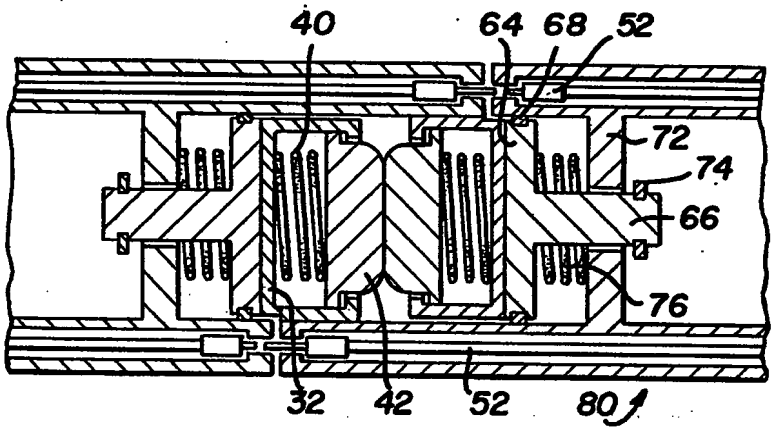
40
64
68
52
72
74
66
76
32
42
52
80

FIG.6

DESCRIPTION

COUPLING SYSTEM, ESPECIALLY FOR A CONNECTOR

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to hermaphroditic coupling systems, and is particularly suitable for use in hermaphroditic connectors for connecting electrical conductors or optical fibres.

Description of the Prior Art

A hermaphroditic connector member is one which can be connected to another connector member identical to itself.

Although many different types of hermaphroditic coupling systems have been proposed, it would be desirable to provide a hermaphroditic coupling member which is extremely simple to couple and which can be used in low temperature environments with gloved hands. Furthermore, it would be desirable to provide a hermaphroditic connector which is relatively small and can minimize the strain on a cable in which it is used as an in-line connector, yet is robust and can withstand rough handling.

SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a hermaphroditic coupling member comprising a mating surface which in the mated condition of the member has 180° rotational symmetry about a transverse axis of the coupling member, the coupling member having a similarly-symmetrical first and second locking conformations such that the first and second locking conformations engage the second and first locking conformations respectively on another identical coupling member when the coupling member is fully mated with the other coupling member but disengage upon limited separation of the coupling members in a principal mating direction orthogonal to the transverse axis, and the coupling member includes resilient means constructed and located to urge the two members towards their fully-

mated condition. Preferably, the coupling member comprises an optical fibre or electrical connector member.

Also in accordance with this invention, there is provided a hermaphroditic optical fibre or electrical connector member, comprising a body having a stepped end profile comprising two spaced parallel semi-annular transverse surfaces at the forward and rearward ends of a longitudinal planar portion which lies between them; and an axial longitudinal channel formed on the planar portion; an axial member at the forward end of the channel; a recess, and a projection sized so as to engage with the corresponding recess on an opposed identical connector member, located one on the axial member and the other at the rearward end of the channel; and an abutment surface at the rear end of the axial member, the abutment surface being formed on an abutment member which is resiliently urged in a rearwardly direction; the axial space between the axial member and the rearward transverse surface being sufficient to receive laterally the axial member on an opposed identical connector member when the said abutment surfaces of the connector members are displaced against their resilient bias.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of an optical fibre connector member embodying the invention;

Fig. 2 is a sectional view of the connector member of Fig. 1 with a second member shown in outline, the section not passing through fibres of the connector member;

Fig. 3 is a sectional view of two coupled connector members;

Fig. 4 is a perspective view of a second connector member embodying the invention;

Fig. 5 is a sectional view of a third connector member embodying the invention, the section passing through fibres of the connector member;

Fig. 6 is a sectional view of two coupled connector members of similar type to that shown in Fig. 5; and

Fig. 7 is a perspective view of a fourth connector member embodying the invention.

With reference to Figs. 1 to 3 of the drawings, the hermaphroditic connector part or member generally indicated as 10 comprises a cylindrical body 12 having a body portion 14 of annular section and a projecting portion 16 which is semi-annular in cross-section. The body portion 14 and the projecting portion 16 are coaxial, of the same diameter, and are integrally formed. The bore 18 of the body portion 14 and the channel 20 of the projecting extension 16 are of the same diameter, and are aligned.

The general shape of the end of the body 12 is thus stepped and comprises a transverse substantially planar portion 22, a first semi-annular surface 24 being the end of the cylindrical body portion 14, and a second semi-annular surface 26 being the end of the projecting portion 16. The two surfaces 24, 26 are parallel to each other and, as shown, are also perpendicular to the planar portion 22.

Disposed at the outer end of the projecting portion 16, that is, at the end remote from the cylindrical body portion 14, is a coupling assembly generally indicated as 30. The coupling assembly comprises a circular cylindrical boss 32, of diameter slightly less than the diameter of the channel 20, glued or otherwise fixed into the channel 20 such that the outer end 34 of the boss projects beyond the end 26 of the projecting portion 16 of the body 12. The boss 32 has a peripheral wall portion 36, extending from its outer end 34 back part-way towards the cylindrical body portion 14, the wall portion 36 having an inwardly turned lip 38 (Fig. 2) behind which the remaining parts of the coupling

assembly 30 are entrapped. These parts are a helical spring 40, and a cap 42, which has a convex or domed surface 44 facing rearwardly towards the hollow cylindrical body portion 14. The spring 40 is located between the inner face of the outer end 34 of the boss 32 and the widened flat inner face 46 of the cap 42. The cap 42 and spring 40 are trapped by means of a flange portion 48 around the periphery of the cap 42, in co-operation with the lip 38 of the boss 32.

Thus, there is formed between the domed surface 44 of the cap 42 and the surface 24 of the body portion 14 a space 50. The axial length A of the coupling assembly 30 slightly exceeds the remaining length B of the channel 20, but the assembly is sufficiently compressible against the spring 40 for a compressed axial length A' not to exceed the new remaining channel length B'. The coupling assembly 30 is so dimensioned that when a second connector is brought up to the first connector, the domed surface 44 of the respective caps 42 may abut one another.

Optical fibres run parallel to the axis of the connector member in a symmetrical array within the wall of the connector body. Fibres 52 are shown (Figs. 1 and 2) projecting beyond the end 26 of the projecting portion 16 of the connector member. The ends of longitudinal bores 53, each of which houses a fibre, are shown (Fig. 1) at the end 24 of the cylindrical body portion 14. These latter fibres terminate before reaching the end 24, the distance between their ends and the end 24 slightly exceeding the distance by which the fibres 52 project beyond the end 26 of the projecting portion 16. When the connector members are coupled to form the connector of Fig. 3, the fibres of the respective connector members are in optical alignment, with the projecting parts of the fibres 52 within the opposed bores 53.

It will be seen that the connector system has a principal axis 54 which is its longitudinal axis, and

also a transverse axis 56 orthogonal to the principal axis and about which the mating surfaces of the connector exhibit 180° rotational symmetry. Thus in the connector part 10 illustrated in Figs. 1 to 3, there is a stepped mating surface comprising the central substantially planar portion 22, intersecting the transverse axis 56, and the first and second semi-annular surfaces 24 and 26, these being parallel to each other and, in the illustrated and preferred example, perpendicular to the planar portion 22. The boss 32 and space 50 maintain this rotational symmetry. Other shapes could however in principle be provided for the mating surface provided only that the 180° rotational symmetry about axis 56 exists and providing that the projecting end 34 of the boss 32 is capable of being retained in engagement with the bore 18 on an associated coupled connector member as will be described in more detail below. The shape shown is however particularly desirable because it is relatively easy to form by machining from cylindrical metal section. Furthermore the flat surfaces 24, 26 are accessible to be wiped clean before a connection is made.

To couple two connector members together the first connector member 10 and a second connector member 58 are positioned side by side as indicated in Fig. 2. The two members are then moved laterally together and first the projecting end 34 of the boss 32 on each member will bear against the surface 24 at the end of the cylindrical body portion 14 of the body 12. As they are moved closer together, the domed surfaces 44 of the caps 42 of the two members will bear against each other and the caps 42 will be forced back against the springs 40, which will be compressed. The domed shape of the surfaces 44 of the caps 42 is such as to facilitate this transverse sliding movement. Eventually the two connector members will reach a position in which they are axially aligned on the longitudinal axis 54. When this happens each projection 34 will be able to move

into the end of the opposed bore 18 and the two connector members will be pushed by the expanding springs 40 into their fully mated condition, as shown in Fig. 3. In this condition the surface 24 on one connector member closely abuts the surface 26 on the other connector member, and the central planar portions 22 also bear against one another. The optical fibres 52 on the two connector members are thus aligned, with the parts of fibres 52, projecting from the semi-annular surface 26 positioned within the bores 53 at the surfaces 24. Transmission can thus take place between the fibres so aligned.

It is seen that in this way the coupling system provides for the mating surfaces 24 and 26 to be held apart until the connector members are axially aligned, enabling connector members to be used which have delicate components projecting beyond the mating surfaces 24 and 26, e.g., the fibres 52 in the example described above. Moreover, the coupling operation is achieved very simply with a snap-in action. This is facilitated by having the compressive resilient force applied to a rearwardly facing portion, i.e. the surface 44 of cap 42 of the connector member.

When in the coupled condition, the boss 32 engages in the channel 20 of the opposed connector member as its projecting end 34 engages in bore 18 and ensures transverse alignment of the two connector parts. The projecting end 34 is restrained from lateral outward movement by the wall of the cylindrical body portion 14, particularly that part of the wall diametrically opposed to the semi-cylindrical portion 16, or the uppermost part as seen in Fig. 1.

The purpose of the bore 18 is simply to provide a recess to receive the boss 32, and indeed in the alternative construction shown in Fig. 4 the projection and recess can be inter changed so that there is a recess 59 defined at the end 34 of the boss 32, and a projection 60 extending from the end 24 of the

cylindrical body portion 14, the projection 60 taking the place of the bore 18. With either embodiment a locking conformation is provided which inhibits separation of the connector members so long as they remain in the longitudinal relationship of the type shown in Fig. 3.

The coupling operation is extremely simple and lends itself to situations where coupling is required in a low-temperature environment with gloved hands. No screw or bayonnet coupling is necessary to ensure proper mating of the connector parts.

The connector can be small in bulk and thus can minimize the strain on a cable in which it is used as an in-line connector. Nevertheless it is robust and can be made to withstand rough handling.

To uncouple the connector members all that is necessary is to pull them apart axially compressing the springs 40 sufficiently to disengage the projecting end 34 of the boss 32 from the end of the bore 18. The connector members 10, 58 will then move apart transversely and separate. It is thus seen that the connector has a 'snatch disconnect' property, and can be used in particular circumstances where this is required, e.g. for attaching a motor cyclist's headphones to his machine. Accidental uncoupling by an inadvertent longitudinal pull may be prevented by providing the connector, or each connector member, with an outer sleeve which has a locking and unlocking mode.

A third connector member 60 embodying the invention is shown in Fig. 5. This differs from the first embodiment in two ways. Firstly, there is provided a leaf spring 62 to assist uncoupling of two mated connector members. This spring 62 is provided for ensuring decoupling upon an axial pull, though in practice it may not normally be necessary. Secondly, there is provided sealing means to resist the ingress of foreign matter into the bore 18 of the cylindrical body portion 14.

The sealing means comprises a plate 64 and a stub 66 integral therewith and projecting rearwardly from the plate into the bore 18. The plate is slidable within the bore 18 and has an O-ring seal 68 around its periphery in sealing contact with the bore. A part of the stub 66 is located within an aperture 70 formed centrally in a seating 72, which is integral with the wall of the hollow cylinder body portion 14. The stub and plate are thereby constrained to move along the axis of the bore. On the free end of the stub 66 is located an abutment washer 74 to engage the side of the seating 72 remote from the projecting portion 16 and thereby retain the plate and stub within the bore 18.

Between the plate 64 and the seating 72 is located a spring 76 of lower spring force than the spring 40 of the coupling assembly.

In Fig. 5, two optical fibres 52 are shown, diametrically disposed to one another within the wall of the connector member.

The mated connector members 80 of Fig. 6 differ from the connector members of Fig. 5 only in that no leaf springs 62 are provided. The two connector members are coupled together in the manner which has been described above with reference to Fig. 3. Unlike the connector members of Fig. 3, the springs 40 of the coupled connectors cannot fully relax. When they begin to relax, the springs 76 are compressed, opposing further relaxation. The springs 40, 76 reach a state of equilibrium whereby they are subject to an equal compressive force. The springs 40 can, however, relax sufficiently to enable the bosses 32 to be received in the ends of their respective bores 18.

Fig. 7 shows a connector member similar to that described with reference to Figs. 1 to 3, but with a different arrangement of the optical fibres. The fibres 52, two of which are shown in the drawing, are disposed in longitudinal V-shaped notches 82 formed at the surface of the connector body 12. Optical fibres 52

project beyond the semi-annular surfaces 26 and terminate before reaching the semi-annular surface 24. The ends of notches 82 adjacent the surface 24 are covered with leaf springs 84. After joining two such connectors in the manner previously described a sleeve 86 may be slid to cover and protect the fibres 52 in the region of the join. When the sleeve 86 is in position the members cannot be uncoupled, so the snatch disconnect facility is of course lost.

The connector members described are formed of brass, although other suitable materials, metallic and non-metallic such as plastics, may be used. Belleville springs may be used instead of the helical springs 40, 76, described.

A connector embodying the invention can also be used to join electrical conductors. In one embodiment the cylindrical and non-cylindrical parts are of insulating, plastics material and conduction occurs through the metallic parts which comprise the coupling assembly. The connection between an electrical line and the boss of the connector may be achieved by a simple plug and socket contact arrangement.

However in a preferred alternative arrangement electrical plug and socket type contact members are substituted for the optical fibre terminations shown around the periphery of the body member 12 in the embodiments of Figs. 1 to 6. Conveniently the contacts opening onto the end surface 24 of the cylindrical body portion will be of the plug type while those openings onto the end surface 26 of the projecting extension will be of the socket type.

Many other embodiments of connectors according to the invention, for use with optical or electrical systems, can be envisaged. Different arrangements of coupling assembly are possible, and the invention is not limited to the use of circular cylindrical sections, although these may often be the most convenient embodiments of the invention. For example, elliptical

or rectangular section connectors could be used. Finally, the coupling system could have application for other purposes, e.g. for coupling hydraulic lines.

WE CLAIM:

1. A hermaphroditic coupling member comprising a mating surface 24, 26 which in the mated condition of the member has 180° rotational symmetry about a transverse axis of the coupling member, the coupling member having similarly-symmetrical first and second locking conformations 18, 32 such that the first and second locking conformations engage the second and first locking conformations respectively on another identical coupling member when the coupling member is fully mated with the other coupling member but disengage upon limited separation of the coupling members in a principal mating direction orthogonal to the transverse axis, and the coupling member includes resilient means 40 constructed and located to urge the two members towards their fully-mated condition.

2. A coupling member according to claim 1, in which the resilient means comprises a compressively-resilient structure, and the mating surface comprises a portion 44 facing rearwardly of the principal mating direction of the coupling member, the resilient means being effective on the said rearwardly-facing portion, whereby in the coupling operation the other coupling member is introduced transversely into axial alignment with the first coupling member under compression of the resilient means whereupon the resilient means urges it into its fully-mated condition.

3. A coupling member according to claim 2, in which the locking conformations comprise a longitudinal projection 32 and a longitudinal recess 18, one of the locking conformations 32 being located about the principal mating axis at the forward end of the coupling member and the other locking conformation 18 being located about the same axis rearwardly of and opposed to the said rearwardly facing portion 44 of the mating surface.

4. A coupling member according to claim 3, wherein said coupling member comprises an optical fibre or

electrical connector member.

5. A hermaphroditic optical fibre or electrical connector member, comprising a body 10 having a stepped end profile comprising two spaced parallel semi-annular transverse surfaces 24, 26 at the forward and rearward ends of a longitudinal planar portion 22 which lies between them; an axial longitudinal channel 20 formed on the planar portion 22; an axial member 32 at the forward end of the channel; a recess 18, and a projection 34 sized so as to engage with a corresponding recess on an opposed identical connector member, located one on the axial member and the other at the rearward end of the channel; and an abutment surface 44 at the rear end of the axial member 32, the abutment surface being formed on an abutment member 42 which is resiliently urged in a rearwardly direction; the axial space 50 between the axial member 32 and the rearward transverse surface 24 being sufficient to receive laterally the axial member on an opposed identical connector member when the said abutment surfaces of the connector members are displaced against their resilient bias.

6. A connector member according to claim 5, including a sleeve member 86 slidably mounted on the body between locked and free positions for retaining an opposed identical connector member in mated engagement.

7. A connector member according to claim 5, in which the abutment surfaces 44 are domed.

8. A connector member according to claim 5 in which the axial member is a hollow boss 32 and the abutment member 42 is retained in and protrudes from the rearward portion of the boss.

9. A connector member according to claim 8, in which the projection is on the axial member 32 and projects forwardly of the forward transverse surface 26, and the recess 18 is at the rearward end of the channel 20.

10. A connector member according to claim 5, including a sealing member 64 slidably mounted in the

recess and biased outwardly of the recess to resist the ingress of contaminants into the recess.

11. A connector member according to claim 5, including resilient ejecting means 62 for urging the axial member 32 on a mated connector member laterally outwardly of the channel 20 upon disengagement of the locking conformations.

12. A connector member according to claim 11, in which the resilient ejecting means comprises a leaf spring 62 in the base of the channel longitudinally between the abutment surface and the rearward transverse surface.

13. A connector member according to claim 5, in which optical fibres 52 are disposed radially around the connector body 10 in such an array as to provide alignment of fibres when two connector members are mated.

14. A connector member according to claim 13, in which the optical fibres 52 are located in notches 87 disposed at the outer periphery of the body, there being provided means 86 for protecting the optical fibres of two coupled connectors.

European Patent Office

EUROPEAN SEARCH REPORT

0121610

Application number

EP 83 11 3235

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	GB-A-1 538 801 (CANNON ELECTRIC [GREAT BRITAIN] LTD.) * Page 1, line 69 - page 2, line 40; figures 1-3 *	1,4	G 02 B 7/26 H 01 R 13/28
A		2,5,6	
X	US-A-4 289 366 (D.H. MARKS) * Column 3, line 67 - column 4, line 69; figures 1,2 *	1	
A		3-5	
A	PATENTS ABSTRACTS OF JAPAN, vol. 3, no. 41 (E-103), 10th April 1979, page 130 E 103; & JP - A - 54 21 356 (MITSUBISHI DENKI K.K.) 17-02-1979 * Whole document *	1,4,5	
A	GB-A-1 567 636 (BOWTHORPE-HELLERMAN LTD.)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

G 02 B
H 01 R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12-06-1984	MORRELL D.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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